 doi 10.3969/j.issn.1673-4254.2015.10.04 J South Med Univ, 2015, 35(10): 1384-1389

临床研究

冠状位髁间窝宽度指数与骨关节炎的关系

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摘要:目的 以冠状位髁间窝宽度指数(NWI)为依据,探讨膝关节骨性关节炎(OA)与髁间窝狭窄之间的关系。 **方法** 收集膝OA诊断明确的中老年患者的MRI图像,依据K-L评分,把OA患者分为轻度OA组42例,中重度OA组37例,分别与健康组70例进行对比。计算MRI冠状位不同层面上的髁间窝宽度指数(NWI)、NWI-A、NWI-P,并根据轴位图像把髁间窝形状分为A、U、W三型。确定OA与NWI、NWI-A、NWI-P、髁间窝分型之间的关系,绘制不同平面NWI的ROC曲线得出最佳界值,依据界值确定髁间窝狭窄的指标。**结果** 健康、轻度OA、中重度OA组MRI图像冠状位NWI分别为0.252±0.019、0.251±0.017、0.240±0.020,NWI-A分别为0.261±0.024、0.259±0.023、0.245±0.023,NWI-P分别为0.271±0.026、0.270±0.024、0.254±0.022。中重度OA组NWI、NWI-A、NWI-P明显比其他两组小(P<0.05),且各层面NWI与是否患中重度OA均有显著的相关性(P<0.01)。冠状位NWI<0.248、NWI-A<0.256、NWI-P<0.266可以作为髁间窝狭窄的指标。在髁间窝狭窄的患者中A型居多(P<0.05)。 **结论** 中重度OA患者存在明显的髁间窝狭窄,A型比U型容易狭窄。
关键词:骨性关节炎;髁间窝狭窄;髁间窝宽度指数;髁间窝形状;核磁共振

Relationship between coronal intercondylar notch width index and osteoarthritis

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Abstract: Objective To study the relationship between knee osteoarthritis (OA) and intercondylar notch narrowing based on the notch width index. **Methods** Magnetic resonance (MR) images were collected from middle-aged and elderly patients with a definite diagnosis of knee OA, including 42 with mild OA and 37 with moderate to severe OA, with 70 healthy individuals serving as the control group. The notch width indexes NWI, NWI-A, and NWI-P on the coronal images at different levels were calculated, and the intercondylar notch was classified, according to the features on axial MR images, into types A, U, and W. The association of OA with NWI, NWI-A, NWI-P, and notch type was determined, and the cutoff values were obtained based on the ROC curves at different levels as indicators for diagnosis of intercondylar notch stenosis. **Results** In the control, mild OA, moderate to severe OA groups, the NWI value on coronal MR images were 0.252±0.019, 0.251±0.017, and 0.240±0.020, NWI-A were 0.261±0.024, 0.259±0.023, and 0.245±0.023, and NWI-P were 0.271±0.026, 0.270±0.024, and 0.254±0.022, respectively. Patients with moderate to severe OA had significantly smaller NWI, NWI-A, and NWI-P than the other two groups (P<0.05), and a significant association was found between NWI values at each level and the occurrence of moderate to severe OA (P<0.01). A NWI value<0.248, NWI-A<0.256, and NWI-P<0.266 supported a diagnosis of intercondylar notch narrowing. Type A intercondylar notch was found in the majority of patients with intercondylar notch narrowing (P<0.05). **Conclusion** Patients with moderate to severe OA have significant intercondylar notch narrowing, and patients with a type A intercondylar notch are more likely to have intercondylar notch narrowing than those with type U notch.
Key words: osteoarthritis; intercondylar notch narrowing; notch width index; intercondylar notch shape; magnetic resonance imaging

膝关节骨性关节炎(osteoarthritis, OA)是由于关节软骨破坏,骨赘大量形成,最终导致关节间隙狭窄的一种疾病,好发于老年人,女性多于男性,会导致严重的关节疼痛甚至丧失运动能力。OA没有较好的治疗方法,轻度病人常保守治疗,严重病人常采用膝关节置换。鉴于OA严重的后果及昂贵的治疗费用,应加强对高危人群的预防治疗。

Wada等[1]和León等[2]研究发现OA患者由于髁间窝内骨赘增生从而会导致髁间窝狭窄。为了准确评价髁间窝狭窄,人们提出了髁间窝宽度指数(notch width index, NWI)的概念,NWI=髁间窝宽度/股骨髁宽度,为

收稿日期:2015-06-14
基金项目:国家自然科学基金(81450042);甘肃省青年科技研究基金(1107RJYA027);兰州市科技发展计划项目(2014-2-27)
Supported by National Natural Science Foundation of China (81450042).
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相对指标,能降低测量误差,平衡个体差异,较准确的反应髁间窝大小[3-4]。Souryal[4]、Keays[5]等在X线,van Eck等[6]在CT图像上分别测量了冠状位序列的NWI,Domzalski[7]、Sonnery-Cottet[8]、Park[9]等在MRI图像上测量了冠状位NWI,Hoteya等[10]为了更好的说明前交叉韧带(ACL)止点处髁间窝宽度,测量了冠状位ACL股骨止点处图像的NWI-A及其后序列的NWI-P。但以上学者所得数据均有较大差异,而且到目前为止还没有明确的针对OA病人的冠状位NWI界值来确定髁间窝狭窄的标准。因此本研究中我们选取诊断明确的OA病人为研究对象,采用髁间窝软组织成像较好的MRI图像进行研究,统一了测量标准,并增加了样本量。

1 资料与方法

1.1 研究对象

我们回顾性分析了2011年1月~2014年12月在兰州大学第二医院拍摄膝关节核磁的1107例门诊和住院病人的病例资料。纳入标准:(1)中老年人(≥45岁);(2)依据中华医学会风湿病学分会OA诊断标准[11]确诊为膝OA,且无明确外伤或手术史,并选取膝关节完全正常的健康人作为对照;(3)MRI图像清晰,序列完整。排除标准:(1)<45岁;(2)有膝关节外伤或手术史造成髁间窝破坏;(3)诊断不明确;(4)MRI图像不清晰或序列不完整。本研究在伦理委员会的监督下进行,并取得病人的知情同意。依据X线平片和MRI图像,采用K-L评分标准[12-13]分组,0级:正常;Ⅰ级:关节间隙可疑变窄,可能有骨赘;Ⅱ级:有明显骨赘,关节间隙可疑变窄;Ⅲ级:中等量骨赘,关节间隙变窄较明显,有硬化性改变;Ⅳ级:大量骨赘,关节间隙明显变窄,严重硬化性病变及明显畸形。Ⅰ、Ⅱ级为轻度OA,Ⅲ、Ⅳ级为中重度OA。并与Lequesne制定的膝OA严重指数(ISOA)评分[14]相对照,1~4分为轻度OA,大于4分为中重度OA。

1.2 测量方法

采用phillips 3.0-T MRI扫描仪,患者仰卧位,膝关节屈曲10°~15°,线圈中心位于髌骨下极水平。扫面序列:冠状位和轴位,层厚3 mm。选取冠状位序列中显示髁间窝最清楚的图层,用RadiAnt DICOM Viewer 1.9软件进行测量,髁间窝宽度指数(NWI)=髁间窝宽度(N)/股骨髁宽度(W),NWI测量参照Domzalski等[7]的测量标准,NWI-A、NWI-P的测量参照Hoteya等[10]的测量标准(图1)。选取轴位序列中显示髁间窝最清楚的图层,参照Al-Saeed等[15]的标准进行分型,分为A、U、W三型(图1)。由3人独立完成,数据取平均值,分型不一致时协商解决。

1.3 统计分析

数据用SPSS 22.0软件进行统计分析,结果以均数±标准差的形式表示。不同层面不同分组间NWI的比较采用单因素方差分析,率的比较采用χ^2检验,相关

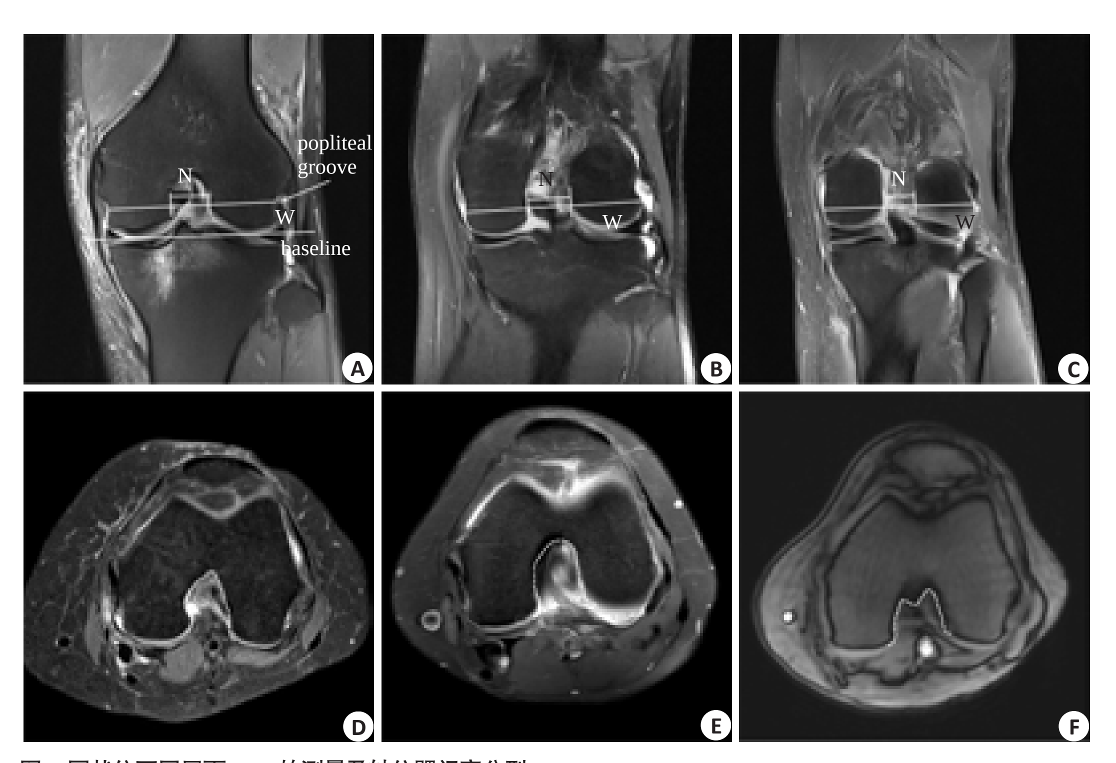


图1 冠状位不同层面NWI的测量及轴位髁间窝分型

Fig.1 Measurement of NWI at different levels in coronal MR images and intercondylar notch shape typing on axial images. *A*: NWI; *B*: NWI-A; *C*: NWI-P; *D*: Type A; *E*: Type U; *F*: Type W.

性检验采用Spearman非参数检验。$P<0.05$为差异有统计学意义。

2 结果

2.1 一般资料

如表1,收集到符合条件的病历有健康组70例,轻度OA组42例,中重度OA组37例。

表1 不同分组的性别、年龄

Tab.1 Gender and age (year) in different groups

	Healthy Group		Mild OA Group		Moderate-severe OA Group	
	n	Age	*n*	Age	*n*	Age
Male	32	53.69±6.42	18	54.33±6.83	9	60.67±10.04
Female	38	52.32±6.18	24	53.17±5.11	28	61.11±9.90
Total	70	52.94±6.28	42	53.67±5.86	37	61.00±9.79

2.2 不同分组间冠状位不同层面NWI对比

如表2,在冠状位上,轻度OA组NWI、NWI-A、NWI-P与健康组相近,无统计学差异(F=0.221/0.064/0.033, P=0.639/0.801/0.856)。中重度OA组NWI、NWI-A、NWI-P均明显小于健康组,差异有统计学意义(F=9.876/10.010/11.783, P=0.002/0.002/0.001)。中重度OA组各层面NWI均明显小于轻度OA组差异有统计学意义(F=6.657/7.361/9.873, P=0.012/0.008/0.002)。

表2 不同层面不同分组间NWI的比较

Tab.2 Comparison of NWI in different sequences between different groups

	Healthy Group		Mild OA Group		Moderate-severe OA Group	
	Mean±SD	95% CI	*Mean±SD*	95% CI	*Mean±SD*	95% CI
NWI	0.252±0.019	(0.248,0.257)	0.251±0.017	(0.245,0.256)	0.240±0.020*#	(0.233,0.247)
NWI-A	0.261±0.024	(0.255,0.266)	0.259±0.023	(0.252,0.267)	0.245±0.023*#	(0.238,0.253)
NWI-P	0.271±0.026	(0.265,0.278)	0.270±0.024	(0.263,0.278)	0.254±0.022*#	(0.247,0.262)

*Mild OA group complicated with healthy group $P<0.01$, #Moderate-severe OA group complicated with mild OA group $P<0.05$.

2.3 相关性检验

由于中重度OA组与健康组各层面NWI均有显著差异,因此做这两组之间的Spearman相关性检验,NWI、NWI-A、NWI-P与中重度OA的相关系数为r=-0.251、-0.276、-0.302,说明NWI、NWI-A、NWI-P均与是否患中重度OA有显著相关性($P<0.01$)。

2.4 ROC曲线

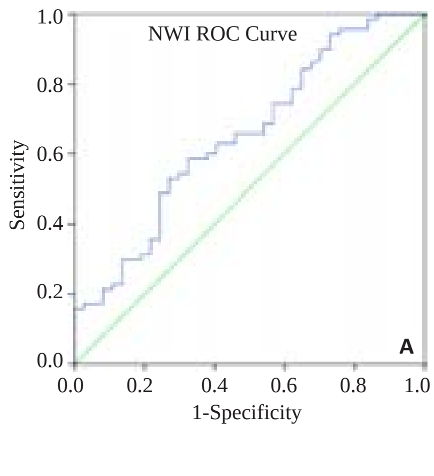
中重度OA组与健康组得到NWI、NWI-A、NWI-P的ROC曲线,NWI的曲线下面积为分别为0.652、0.668、0.683,最佳界值为约登指数(敏感性+特异性-1)最大点对应的值,得出最佳界值为分别为0.248、0.255、0.266(图2)。

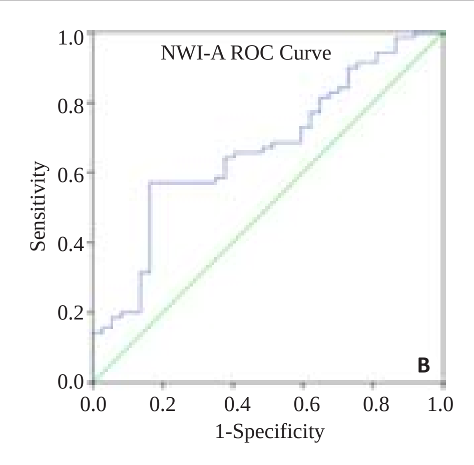
2.5 髁间窝狭窄患者分型的比较

在健康和中重度OA组,分别以NWI<0.248、NWI-A<0.256、NWI-P<0.266作为髁间窝狭窄的依据。在健康组中有W型2人,其NWI、NWI-A、NWI-P均比界值大,被分到髁间窝非狭窄组。因W型较少且髁间窝宽度较宽,NWI较大,与U型接近,所以把W型合并为U型。在冠状位NWI层面,A型在髁间窝狭窄组中的比例77.4%,大于非狭窄组55.6%,U型在髁间窝狭窄组中的比例22.6%,小于非狭窄组44.4%,有统计学差异(P=0.017)。在冠状位NWI-A层面,A型在髁间窝狭窄组中的比例81.7%,远大于非狭窄组46.8%,U型在髁间窝狭窄组中的比例18.3%,远小于非狭窄组53.2%,有显著统计学差异($P<0.05$)。在冠状位NWI-P层面,A型在髁间窝狭窄组中的比例83.3%,远大于非狭窄组44.7%,U型在髁间窝狭窄组中的比例16.7%,远小于非狭窄组55.3%,有显著统计学差异($P<0.01$,表3)。

3 讨论

众多学者对OA病人的髁间窝进行了研究,Shepstone等[16]发现,健康人髁间窝内侧壁比较凹而OA患者内侧壁比较直甚至凸出,这种形态差异可能会减小髁间窝宽度。Wada等[1]和León等[2]发现OA患者髁间窝内可出现各种类型的骨赘增生,其中以顶端和开口处增生最常见,这种增生必然会减小髁间窝宽度,导致





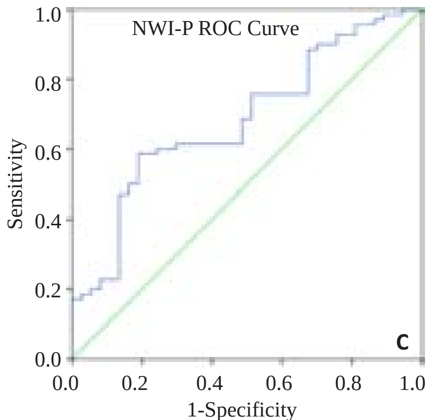


图2 不同层面NWI的ROC曲线

Fig.2 ROC curves of different sequences in moderate to severe OA and healthy groups.

表3 不同层面髁间窝狭窄与非狭窄组髁间窝分型的比较

Tab.3 Comparison of intercondylar notch type between intercondylar notch narrowing and non-narrowing groups in different sequences

	NWI		NWI-A		NWI-P		Total
	Non-narrowing	Narrowing	Non-narrowing	Narrowing	Non-narrowing	Narrowing	
A	30(55.6%)	41*(77.4%)	22(46.8%)	49*(81.7%)	21(44.7%)	50*(83.3%)	71
U	24(44.4%)	12*(22.6%)	25(53.2%)	11*(18.3%)	26(55.3%)	10*(16.7%)	36
Total	54	53	47	60	47	60	107
Statistics	χ^2=5.695, *P*=0.017		χ^2=14.344, *P*=0.000		χ^2=17.637, *P*=0.000		

*intercondylar notch narrowing group complicated with non-narrowing group *P*<0.05.

NWI减小,形成髁间窝狭窄。我们研究发现中重度OA患者NWI、NWI-A、NWI-P均明显小于健康人和轻度OA患者(*P*<0.05),说明中重度OA患者有明显的髁间窝狭窄,与以上学者结论一致。而轻度OA患者以上指标均与健康人接近,说明轻度OA患者髁间窝狭窄不明显。

有关冠状位不同层面髁间窝狭窄NWI界值的确定尚有很大争议。Tillman等[17]对200例骨骼标本进行测量发现NWI与性别和人种有关。Souryal等[4]在X线上测量NWI,得出健康人冠状位NWI=0.2338,NWI<0.2为髁间窝狭窄。Keays等[5]发现X线图像会出现重影,正常人的NWI在前面为0.24,后面为0.30,前面NWI<0.2,后面NWI<0.24可认为髁间窝狭窄。van Eck等[6]发现在CT上,不同拍摄方法所测得的NWI各不相同。Sonnery-Cottet等[8]对髁间窝冠状位MRI图像进行测量得出健康人NWI=0.27±0.02,ACL损伤患者的NWI=0.22±0.02,并认为NWI<0.21是ACL损伤的危险因素。Park等[9]测量健康女性的冠状位MRI图像得出NWI=0.25±0.02。Domzalski等[18]测量了76例未成年人髁间窝冠状位MRI图像,发现15-17岁未成年人的NWI=0.254±0.032,且随着年龄的增加而减小。Hoteya等[10]为了更准确的测量ACL股骨止点处的NWI,选取ACL股骨止点层面(A)和之后的一个层面(P),得出NWI-A、NWI-P,健康人的NWI-A=0.266±0.030,NWI-P=0.273±0.033,并认为小于0.25为髁间窝狭窄。

我们得出健康人NWI=0.252±0.019,NWI-A=0.261±0.024,NWI-P=0.271±0.026,与上述研究结果均存在一定差异,可能与人种、拍摄体位、摄像工具、测量方法、测量平面等众多因素有关。我们以ROC曲线约登指数最大点处对应的值为最佳界值,得出冠状位NWI<0.248、NWI-A<0.256、NWI-P<0.266时为髁间窝狭窄的结论,同时发现以上界值均与健康组95%可信区间下限接近,说明ROC曲线所得界值合理。

对于髁间窝分型,Anderson等[3]对CT图像研究发现U型不宜发生狭窄,而侧壁出现波形的髁间窝容易狭窄,van Eck等[19]在关节镜下发现,A型的髁间窝宽度在全段都比U型小。Sutton等[20]发现女性的髁间窝宽度比男性小,且A型较多,说明A型髁间窝容易狭窄。Al-Saeed等[15]发现A型髁间窝较窄,且髁间窝形状是ACL损伤的一个危险因素,A型易发生ACL损伤。我们发现在NWI小于界值的髁间窝狭窄组中A型所占的比例均明显高于非狭窄组,说明A型髁间窝容易发生狭窄,与上述结论一致。

大量研究证实髁间窝狭窄是ACL损伤的独立危险因素,ACL损伤患者的NWI比健康人小[4-5, 7-10, 21]。Stijak[22]、Dienst等[23]认为髁间窝狭窄患者的ACL横截面积较小、强度较弱,生物学性能较差,易发生损伤。Everhart等[24]发现ACL在膝关节运动时可与狭窄的髁间窝发生碰撞,产生磨损,导致ACL损伤。ACL损伤会改变下肢力线,破坏关节软骨,产生关节炎症,导致骨赘增生,骨赘增生后会进一步加重关节磨损,最终导致OA[25]。即使在ACL损伤后进行重建仍不能有效阻止OA的发生[26]。Hernigou[27]和Stein等[28]发现在OA患者中髁间窝宽度或NWI越小,越容易发生ACL损伤。鉴于ACL损伤与OA的这种关系,对髁间窝狭窄的健康人群提前进行预防治疗,不仅能预防ACL损伤,还能预防OA。

综上所述,中重度OA患者存在明显的髁间窝狭窄,冠状位NWI、NWI-A、NWI-P均明显比健康人小,在MRI图像上NWI<0.248、NWI-A<0.256、NWI-P<0.266可以作为髁间窝狭窄的依据,A型的髁间窝比U型更容易发生狭窄,对髁间窝狭窄者采取措施提前预防对OA的发生可起到一定的防治作用。可采取的预防措施主要有定时体检、及时提供防治建议、减轻体质量、限制剧烈体育运动等。但由于本研究仅选取了一家医院的病例进行研究,病例取材范围较窄,样本量不够大,且未考虑是否并发膝关节韧带损伤、半月板损伤等疾病及既往是否关节腔内注射玻璃酸钠等用药情况,因此相关结论需要用多中心大样本研究,全面考虑可能的干扰因素,进一步深入探讨。

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（编辑:吴锦雅）